# TIA-950 Optical/Electrical Converter
# Operating Instructions

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# Introduction

The TIA-950 Optical to Electrical Converter is a convenient battery-operated detector/amplifier combination that mounts directly on the input of an oscilloscope, digitizer, or other readout device. With a band width of DC to 750 MHz, it accurately provides an electrical replica of the optical signal presented to it. It is fully capable of driving a 50 ohm cable terminated in its characteristic load.

The unit comes equipped with an FC style fiber optic connector. Adaptors and/or fiber optic patchcords are available from TTI to interface with other connecotr styles.

The TIA-950 has selectable transimpedances of 1.6KΩ +/- 0.4K plus a post amplifier with selectable gains of 1 or 10. Thus the overall responsivity ranges from approximately 2000 V/W to 20000 V/W at the peak of the detector response curve. Interstage coupling may be switched from DC to AC to avoid saturation of the second stage in those cases where the signal of interest is combined with a relatively large DC optical component.

Each unit is powered by a self-contained 9 V lithium battery. Battery operation eliminates ground loops and the undesirable effects of conducted radiation that may be present on local power lines.



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# Specifications

| | |
|---|---|
| Detector Types | InGaAs (900-1700nm) |
| Transimpedance | 1.2 K |
| Post Amplifier Gain | 1.0, 10.0 selectable |
| Maximum Linear Input Power | 0.8 mW |
| Max Input Without Damage | 10 mW |
| Bandwidth (-3 dB) | DC to 750 MHz at Gain of 1.0<br>DC to 250 MHz at Gain of 10.0 |
| Output Impedance | 50 Ohms |
| Output Connector | Male BNC |
| Fiber Optic Input Connector | FC |
| Input Numerical Aperture | 0.29 |
| Interstage Coupling | DC or AC (100 Hz low frequency cut off) |
| Output Offset Voltage | < +/- 0.75 V at max gain |
| Maximum Output Voltage | 2 V pk-pk, no load, 0.8 V pk-pk, 50 ohm load |
| Noise Level | 3 pW/Hz $^{1/2}$ |
| Power Required | 9 V Lithium Battery powers the unit for approximately 30 hrs (no load) |
| Dimensions | 1.2” W, 2.5”L, 1.5”H, (30.5 mm, 63 mm, 38 mm) |
| Operating Temperature | 0 - 40 C |
| Limited Warranty | 2 Years from date of receipt |
| Weight | 5 oz, 150 g |



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## Unpacking and Inspection

Prior to shipment this instrument was inspected and found to be free of mechanical and electrical defects. Upon acceptance by the carrier he assumes responsibility for its safe arrival. After unpacking, examine the unit for any evidence of shipping damage. Should you receive this instrument in a damaged condition, apparent or concealed, it must be noted on the freight bill or express receipt and signed by the carrier’s agent. Failure to do so could result in the carrier refusing to honor the claim. Upon filing a claim TTI should be notified.

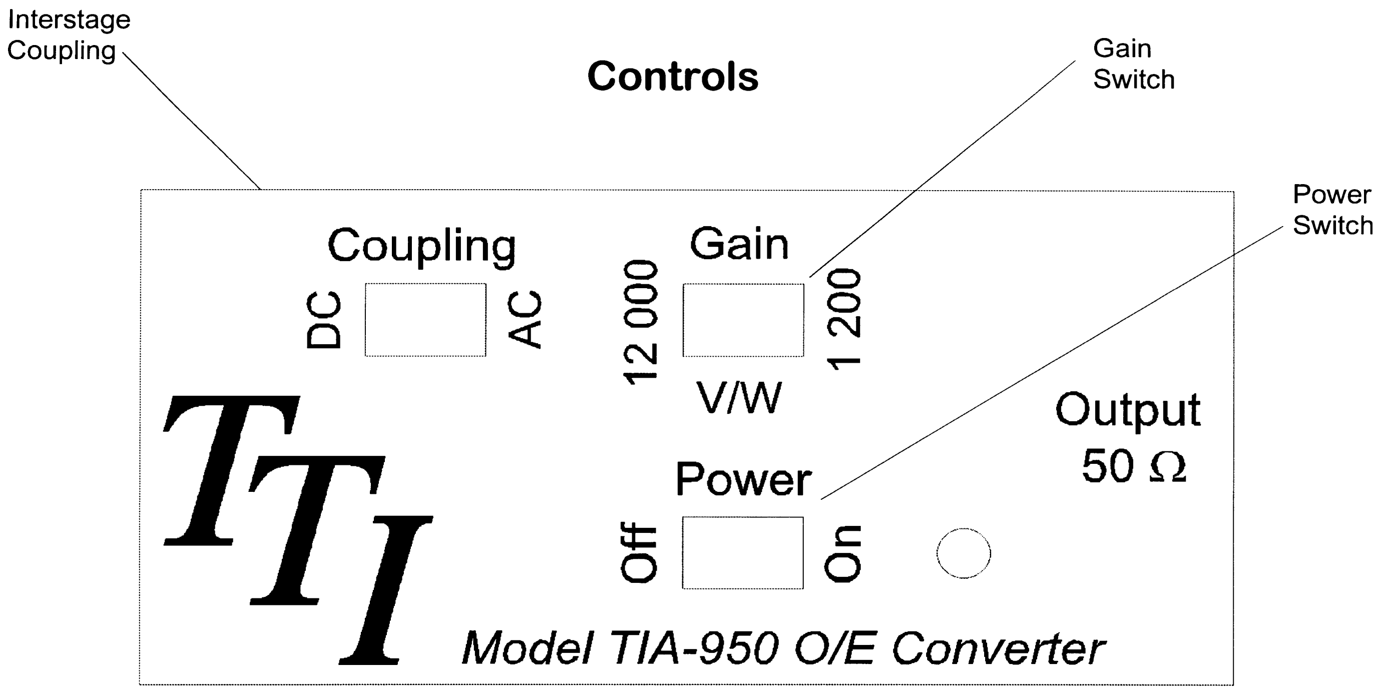
## Battery Replacement

Each unit comes equipped with a 9 V Lithium battery that provides power to the unit for approximately 30 hours of operation. It is recommended that the battery be replaced whenever the output signal becomes clipped at 1.1 volts or less. When replacing the battery, a Lithium unit should be used. Conventional 9 V alkaline batteries may be used if so desired but the useful life will only be about 25 % ( 8 hours) of that of the much higher capacity Lithium types. TTI can supply these batteries if desired. Replacement of the battery may be accomplished by removing the four 2-56 Philips flat head screws that retain the bottom cover of the TIA-950. **DO NOT** attempt to remove the top cover. Take care to replace all screws tightly. This will provide optimum shielding of the unit from ambient radio frequency noise or interference



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## Controls


Interstage Coupling
Gain Switch
Power Switch
Coupling
DC
AC
Gain
12 000
1 200
V/W
Power
Off
On
Output
50 Ω
TTI
Model TIA-950 O/E Converter



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# Operating Considerations

The TIA-950 is comprised of a fiber coupled detector and two amplifier stages. The first amplifier is a transimpedance stage which converts the detector output current to a voltage by passing it through a resistor of 1 200 . Additional amplification is optionally provided by the second stage which also serves to provide 50 ohm drive capability. Either AC or DC coupling between the stages may be selected.

The overall bandwidth of the unit is determined by the first stage transimpedance. It is in excess of 750 MHz when the Gain switch is in the 1200 position and is 250 MHz in the 12000 position. The overall responsivity of the unit in terms of Volts/Watt is the current responsivity of the detector multiplied by the transimpedance and further multiplied by the second stage gain. For example, the sensitivity of the unit at a wavelength of 1300 nm would be 0.8A/W x 1200 V/A x 10 = 10 000V/W.

The selection of AC interstage coupling is useful when the user needs to examine a small signal in the presence of a large DC optical component, (e.g. baseband fiber optic video). This will preclude the last stage from saturating on the DC component. Otherwise, DC coupling should be employed.

When using the TIA-950 mounted on an oscilloscope, the scope should have its input set to either 50 ohm 1 Meg ohm input impedance(bandwidth will be maximum when using 50 ohms). If driving a coaxial cable, the cable should have a 50 ohm characteristic impedance and be terminated with a 50 ohm load. Note that the signal amplitude will be reduced by a factor of two whenever the load is 50 ohms..

The following table summarizes the operation of the unit under various operating conditions.

| Setting / Signal | $T_R$ | AC/DC Coupling | 2nd Stage |
|---|---|---|---|
| Small signal on large DC components | 1.2 K | AC | 1200, 12000 As Needed |
| Signal from DC to 750 MHz | 1.2 K | DC | 1200, 12000 As Needed |



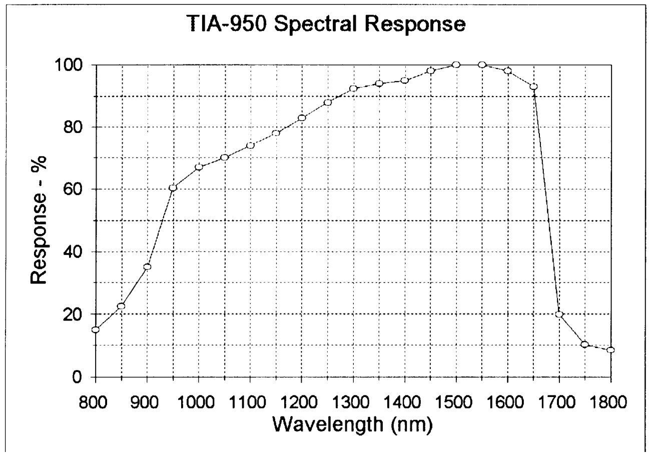
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# Spectral Response

The approximate relative response curves of the detectors employed is as shown below. Note that these are representative curves and do not necessarily correspond to the exact response of the particular detector in use.

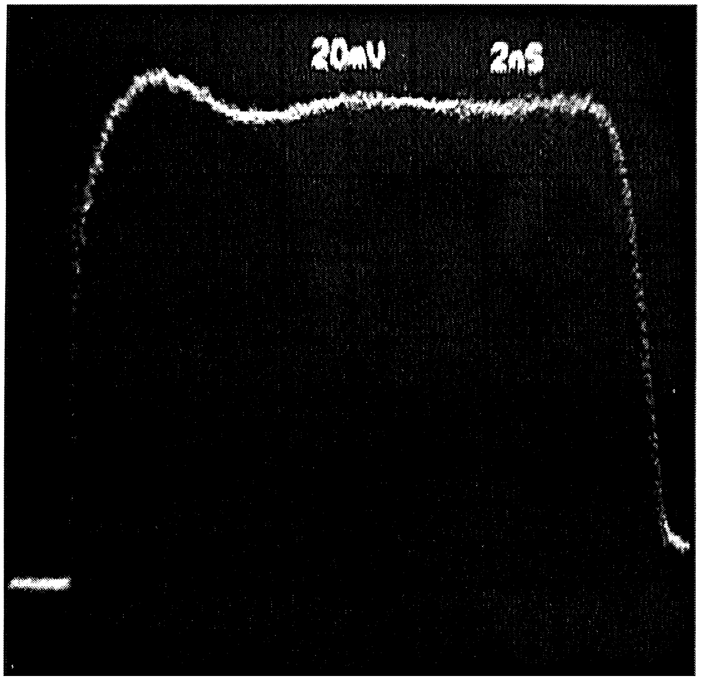
The approximate power at the detector surface is given by:

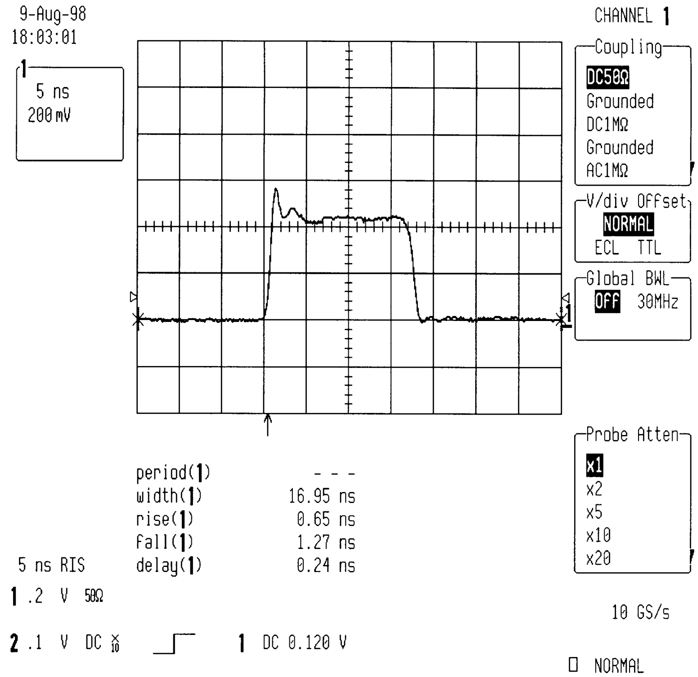
$$\text{Input power in watts (InGaAs)} = \frac{\text{Peak output voltage (no load)}}{0.8\ \text{A/W} \times T_R \times \%\ \text{Relative response from graph}/100}$$






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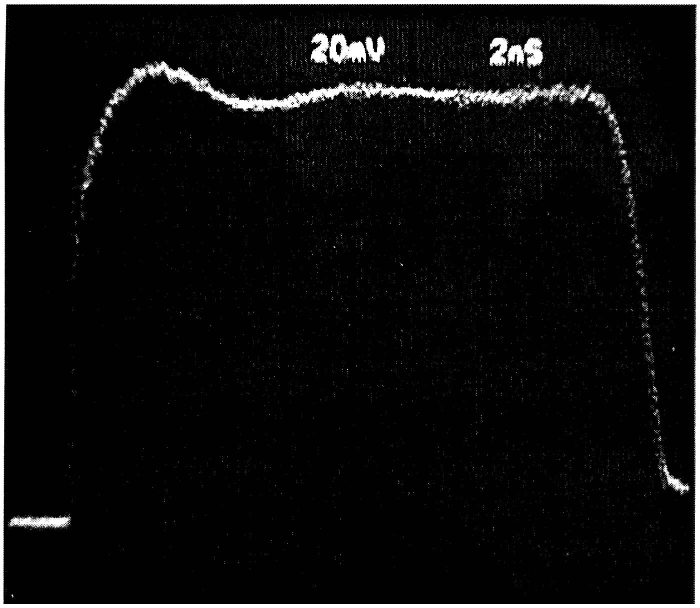




Optical Input

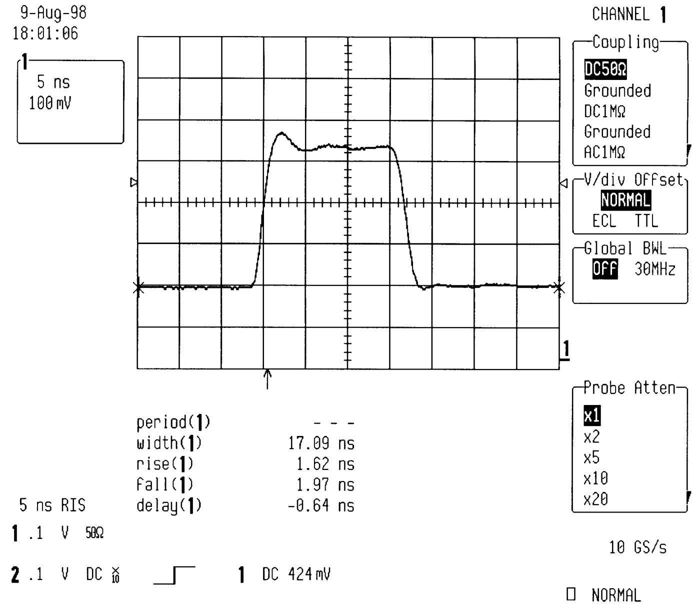
Output; Gain = 1200
(Rise, Fall times Limited
by 500 MHz Scope BW)

**Typical Waveforms**

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Optical Input




Output; Gain = 12000
(Rise, Fall times Limited by
500 MHz Scope BW)

**Typical Waveforms**

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# Warranty And Repair Information

## *REPAIR INFORMATION*

Products manufactured by Terahertz Technologies Inc. are designed and fabricated to provide reliable performance. However, in the event that service is required, both telephone technical assistance and factory repair services are available. Call (315) 736-3642 for information.

For IN-WARRANTY REPAIRS, call us to obtain a Returned Material Authorization number, (RMA Number). All products are to be returned to TTI with freight charges pre-paid. Those products sent under warranty will be returned to our customers pre-paid. We cannot be responsible for returned products that do not reference the TTI RMA number.

For OUT-OF-WARRANTY repairs, services are billable for both time and materials.

**Calibration - This is a qualitative measurement device. No calibration is required or necessary**.

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## *LIMITED WARRANTY*

**TERAHERTZ TECHNOLOGIES INC. ( TTI ) WARRANTS THAT TO THE FIRST PURCHASER, FOR A PERIOD OF TWO YEARS FROM THE DATE OF RECEIPT, THAT THIS PRODUCT (THE PRODUCT) WILL BE FREE FROM DEFECTS IN MATERIALS AND MANUFACTURING. THE FOREGOING WARRANTY IS THE ONLY WARRANTY, EXPRESS OR IMPLIED, GIVEN BY TTI, I.E., THERE IS NO WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE. TTI HEREBY DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY OTHER THAN THE WARRANTY IN THE FIRST SENTENCE TO THE FULLEST EXTENT PERMITTED BY LAW.**

**THE SOLE AND EXCLUSIVE REMEDY UNDER THIS WARRANTY IS REPAIR OR REPLACEMENT AT TTI'S OPTION OF ANY PRODUCT THAT PROVES TO BE DEFECTIVE IN MATERIALS OR MANUFACTURING WITHIN TWO YEARS OF RECEIPT OF THE PRODUCT. NOTE: THIS WARRANTY DOES NOT APPLY TO ANY PRODUCT WHICH HAS BEEN SUBJECT TO MISHANDLING, MISUSE, OR SERVICE BY UNAUTHORIZED PERSONNEL OR TO ANY PRODUCT WHICH HAS BEEN DAMAGED, MODIFIED, ALTERED OR TAMPERED WITH. TO THE FULLEST EXTENT OF THE LAW, TTI DISCLAIMS ALL LIABILITY FOR ANY OTHER DIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES ALLEGED TO BE CAUSED BY A DEFECTIVE PRODUCT, I.E., TTI WILL NOT BE RESPONSIBLE FOR ANY PERSONAL INJURY, PROPERTY DAMAGE OTHER THAN THE COST OF REPLACING THE PRODUCT OR ANY OTHER MONETARY DAMAGE SUCH AS LOST WAGES OR PROFITS CAUSED BY ANY USE, ATTEMPTED USE OR INABILITY TO USE THE PRODUCT. NOTE: BY USING THE PRODUCT, YOU AGREE THAT REPAIR OR REPLACEMENT AT TTI'S OPTION WILL FULLY SATISFY TTI'S WARRANTY OBLIGATION TO YOU, WHETHER IN CONTRACT, TORT, NEGLIGENCE, STRICT LIABILITY OR OTHER APPLICABLE LAW.**



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